PATENT SPECIFICATION

DRAWINGS ATTACHED

1,124,732

1,124,732

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COMPLETE SPECIFICATION

A Duct Rodder

We, CHICAGO PNEUMATIC TOOL COMPANY, of Chicago Pneumatic Building, 6 East 44th Street, New York, United States of America, a corporation duly organized and incorporated under the laws of the State of New Jersey, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention is concerned with a power operated duct rodder designed to advance in a measured step by step manner a cable lead line through an elongated narrow duct. Upon completion of this operation, a heavy cable is tied to one end of the lead line and is drawn through the duct as the lead line is pulled out of the other end of the duct.

In accordance with the invention, there is provided a duct rodder designed to travel step by step through a duct, including a motor comprising a housing and a piston means, one movable axially relative to the other a measured distance when the other is held stationary; and means cooperable with the wall of the duct for holding the housing and piston alternately stationary so as to permit alternate axial movement of one relative to the other, the said means comprising a pair of resilient flexible grippers of greater diameter than the duct, one fixed to the housing and the other fixed to the piston means, both grippers adapted when entered into the duct to be forced by the surrounding duct wall to flex in a particular direction, each gripper adapted when pressured axially in one direction to expand radially and grip the duct wall so as to hold the corresponding housing or piston means, as the case may be, stationary, and adapted when axially pressured in the opposite direction to yieldably relax its grip on the duct wall so as to allow the corresponding housing or piston means, as the case may be, to move axially relative to the other.

A duct rodder is known from United States patent 3,144,240 which utilizes an electric vibratory motor in conjunction with brush-like wall gripping elements mounted to opposite ends thereof. Such rodders advance in a rambling manner at a slow pace in response to vibrating action of the motor; and the brush-like grippers thereof are relatively expensive. The duct rodder of the present invention utilizes a piston type motor to which are attached flexible wall gripping elements having a plurality of radial legs integral with a generally flat surfaced body. The piston type motor causes the grippers to advance through the duct in a positive manner in measured steps and at a relatively fast pace; and the wall gripping elements thereof are relatively inexpensive.

In the accompanying drawings:

Fig. 1 is a longitudinal section through the duct rodder illustrating the invention;

Fig. 2 is a front or right end view of Fig. 1;

Fig. 3 is a rear or left end view of Fig. 1;

Fig. 4 is a detail showing one of the bolts mounting the rear gripping assembly to the housing;

Fig. 5 is a cross section on the irregular line 5—5 of Fig. 1;

Fig. 6 is a cross section on line 6—6 of Fig. 1;

Fig. 7 is a cross section on line 7—7 of Fig. 1;

Fig. 8 is a cross section on line 8—8 of Fig. 1;

Fig. 9 is a cross section on line 9—9 of Fig. 1;

Fig. 10 is a cross section on line 10—10 of Fig. 1;

Figs. 11 and 12 are schematic views show-

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ing respectively the returned and advanced positions of the piston relative to the housing; and further showing the various air flow passages;

Fig. 13 discloses in elevation a modified form which a gripper element may take;

Fig. 14 is a side elevation view of Fig. 13 in association with a duct;

Fig. 15, which is drawn to a reduced scale, is an example of a gripper element for use in a square duct;

Fig. 16 is a further example of a gripper element suitable for use in a square duct; and

Fig. 17 is a fragmentary illustration of a corner of a square duct engaged by a leg of the gripper shown in Fig. 16.

The duct rodder illustrated in the accompanying drawings includes an elongated housing 20 of relatively lesser diameter than the duct 21 in which it is to be received. It has in its forward end an axial recess 22 in which is fitted a piston cylinder 23. The rear end of the cylinder abuts against a thick disc 24 rigidly seated upon a complementary annular shoulder 25 at the bottom of the recess. The cylinder defines a piston chamber 26 in which a piston 27 is pneumatically reciprocable. The piston has en elongated piston ram or rod 28 which extends axially through an annular gland 29. The latter abuts the forward end 30 of the cylinder. A plug 31 screwed into the forward end of the housing has a terminal flange 32 abutting a corresponding end wall 33 of the housing. A group of adjustable screws 34, two being shown, screwed through the plug are pressed against the gland, whereby the cylinder 23 is held rigidly seated against the disc 24. The plug has an axial hole, the wall of which sleeves a stem 36 of the gland. A bushing 37 press fitted into the gland serves as a supporting bearing for the reciprocable piston rod.

Suitable sealing means 38 fitted in the gland about the piston rod seals the piston chamber against air leakage around the piston rod. An O-ring seal 39 is also provided about the periphery of the gland to seal against air leakage from the piston chamber.

Mounted externally of the housing upon a forwardly projecting end of the piston rod is a first duct gripping means or duct gripper assembly 40. This includes an adapter 41 which sleeves a reduced terminal end of the piston rod and abuts at its rear against a shoulder 42. The adapter has a reduced cylindrical stem portion 43 which extends into a complementary axial hole 44 formed in the body of a duct gripping element or gripper 45. The rear face of the gripper abuts an annular shoulder 46 of the adapter. A thick washer 47 sleeving the piston rod has a rear annular face 48 opposing the forward face of the gripper. The gripper is retained between the adapter and washer by means of a nut 49 screwed upon the piston rod. The washer 47 mounts a forwardly-directed ring 51 which facilitates manual withdrawal of the rodder from the end of the duct after the completion of its travel.

The gripper 45 (Figs. 1 and 2) is of circular configuration having front and rear parallel faces 52, 53. It further includes a group of legs 54, here six in number, spaced circumferentially equally apart and extending radially from a central main body portion 55. The gripper is formed of flexible resilient material whereby the leg members are flexible under pressure in either direction away from a normal radial condition, and are flexible to their normal radial condition when such pressure is relieved. Here, the gripper is formed of a tough wear resistant plastic. Plastic material known by the name of Urethane is suitable for this purpose. So as not to interfere with flexing of the legs, the central area 55 of the gripper extends radially beyond the periphery of the washer and adapter elements 47, 41. Further, the diameter of the washer 47 located at the front of the gripper is a little greater than the diameter of the annular shoulder 46 of the adapter at the rear of the gripper, and the latter shoulder is of slight radial extent. This arrangement is desired as it permits not only flexing of the legs but also flexing of a portion of the central body area of the gripper in a rearward direction; and, because of the greater radial expanse of the front washer relative to the shoulder 46, this arrangement allows lesser flexing of the legs and body area in a forward direction.

The gripper 45 is of slightly greater outer diameter than the diameter of the duct 21 in which it is received. When the gripper assembly is entered forwardly into the duct, the leg elements 54 are forced by the surrounding wall of the duct to flex rearwardly, as indicated by the broken line 56 in Fig. 1. It can be seen that, when axial pressure is applied in a forward direction to the gripper assembly, the gripper will slide forwardly over the duct wall. In this action, the tension of the legs against the duct due to the inherent resilience of the gripper material provides a slight but negligible frictional resistance to forward movement of the gripper. The forward peripheral edge 57 of each leg is beveled. This is desired so that when the legs are flexed rearwardly as in Fig. 1, the beveled surfaces of the legs contact the duct wall, thus allowing easier sliding of the gripper forwardly relative to the duct. This beveled surface also serves as a pilot in facilitating initial entry of the gripper into the duct. The beveled surface has a still further advantage, as will later appear.

It can further be seen that, when pressure

is applied axially in a rearward direction to the gripper while its legs are in a rearwardly flexed condition, the washer element 47 acts over the central body area of the gripper to force the body as well as the legs to flex or expand outwardly. This causes the legs to firmly grip the surrounding wall of the duct and thereby resist rearward movement of the gripper assembly under the applied pressure. In this gripping action, the beveled surface 57 of each leg provides a broader gripping surface in contact with the duct wall than would otherwise be provided by a sharp peripheral corner edge of the leg.

A second duct gripping means or duct gripper assembly 58 (Figs. 1, 3) is mounted to the opposite or rear end of the housing. This assembly includes a circular spacer or closure plate 59 lying flat upon the rear end wall of the housing. Adjoining the closure plate is a gripper support 61. This includes a head section 62 which lies flush upon the closure plate. A group of bolts 63 (Figs. 4—6) screwed fast into the end wall of the housing, rigidly hold the housing, closure plate, and gripper support to one another. Extending axially rearward from the head section is a reduced cylindrical portion 64 having an annular shoulder 65 at its end. Extending axially beyond this shoulder is an externally threaded pipe section 66. The latter extends with a slide fit through an axial hole 67 of a gripper element 68. A nut 69 screwed upon the pipe section 66, together with a washer 71 pressed against the rear face of the gripper 68 holds the latter in rigid abutment wth the annular shoulder 65.

This rear gripper 68 is substantially similar to the forward one. It is of similar outer diameter, and is also formed of the same resilient flexible material. It also has a group of six legs 72 beveled at their peripheral inner edges 70. These legs are, however, of uniform circumferential width, and are narrower than the legs 54 of the forward gripper. The legs 54 of the forward gripper, as appears in Fig. 2, diverge outwardly toward the body area 55. The body area of the forward gripper is also of greater dameter than the body area 73 of the rear gripper. Further, it is noted that the washer 71 and the opposed shoulder 65 of the rear gripper are of equal diameter. The construction and arrangement of the rear gripper as compared with that of the forward one, enables greater flexing of the legs of the rear gripper in either direction, but affords lesser gripping power of the legs against the wall of the duct.

There is an advantage in this difference in structure and arrangement of the forward and rear grippers. During operation of the device, pneumatic power is applied at one time to the rear of the piston 27 to cause the rear gripper 68 to hold the housing 20 stationary, and to advance the forward gripper 45 along with the piston. At the termination of the piston stroke, a strong forward thrust is transmitted to the housing 22 which slightly overcomes the rearwardly acting force of the housing upon the rear gripper. This action serves to advance the entire duct rodder a slightly further distance into the duct. Alternately to this action, pneumatic power is applied to the forward end of the piston. The applied pressure in the latter instance causes the forward gripper 45 to hold the piston 27 stationary and causes the rear gripper 68 to advance forwardly with the housing. Because of the greater load borne by the housing as compared with that borne by the piston, the pneumatic component of force acting in a rearward direction on the piston is prevented by the strong holding characteristics of the forward gripper upon the wall of the duct from pulling the forward gripper rearwardly relative to the housing; and the housing together with the load carried by it is enabled under the component of force acting forwardly on the housing to advance relative to the piston.

The nut element 69 has fixed thereto a cable ring or bail 74 to which a cable lead wire 75 is adapted to be hooked and drawn into the duct as the rodder advances. An operating air supply hose line 76 serves to supply the device with the necessary operating air. This hose line also moves into the duct as the rodder advances. It is axially connected by means of a fitting 77 screwed on the end of the pipe section of the rodder. This hose line as well as the lead wire may extend as much as a thousand feet or more during a duct rodding operation, thus accounting for the added load borne by the housing relative to that of the piston.

Operating air flows from this hose line through the pipe extension 66 into a filter chamber 78 of the rear gripper assembly 61. Disposed in this chamber is an air filter unit 79. The latter includes a cylindrical support 81 received in a counterbore 82. This support is held by means of the closure plate 59 seated against the bottom of the counterbore. An O-ring seal 83 prevents air leakage from the filter chamber around the support 81. Air passing through the filter unit flows through a peripheral channel 84 of the filter support 81 to a passage 85 leading through the head piece 62. This passage communicates through an opening 86 in the closure plate with a main passage 87 in the housing wall. The latter passage (Figs. 1, 6, 7, 11) leads through an inlet port 89 to an annular housing intake channel 91 and through radial ports 92 of an elongated bushing 93 to an air distributor valve chamber 94. O-rings 88 are provided at

opposite ends of the opening 86 of the closure plate to seal against air leakage around the latter.

A distributor slide valve 95 and a drag valve 96 are arranged in the housing in parallel relation to each other rearwardly of the piston chamber. The distributor valve controls the flow of operating air to, and the venting of spent air from opposite ends of the piston chamber 26. The drag valve controls automatic reversing or shifting of the distributor valve from one position to another to effect such alternate flow of operating air to and venting of spent air from the piston chamber.

The distributor valve chamber 94 is defined by the interior of the bushing 93. This chamber is sealed at its rear end by the closure plate 59 and an O-ring 97. The opposite end of the distributor chamber is sealed by the disc 24 and an O-ring 98.

The distributor valve is shiftable back and forth in its chamber. It is cushioned in its movement from impacting against the closure plate 59 and the disc 24 by means of bumper plugs 99, disposed one at each end. Here, the plugs are formed of a suitable plastic such as nylon. The plugs move as a unit with the distributor valve. While here they are not attached to the valve, they could be. An O-ring 101 about the periphery of each plug seals against leakage of operating air to either side of the plug.

The bushing 93, as best indicated in Figs. 11, 12, has a plurality of radial ports 102, 103, 92, 104 and 105 respectively communicating the valve chamber 94 with annular channels 106, 107, 91, 108 and 109. O-rings, as indicated, seal the channels off from one another against air leakage. Channel 106 is connected by a vent 110 to the outside of the housing. Channel 107 connects with an elongated housing intake-exhaust passage 111 which leads through radial ports 112 to the rear of the piston chamber. The intake channel 91, as earlier noted, connects through port 89 with the operating air supply main passage 87. Channel 108 connects with a second elongated housing intake-exhaust passage 113 (Figs. 1, 11, 12) leading through radial ports 114 to the forward end of the piston chamber. And channel 109 is connected by means of a vent 115 to the outside of the housing. A port 116 (Figs. 7, 11, 12) relatively smaller than the inlet port 89 and located close thereto connects the intake channel 91 with a control passage 117 extending through the housing wall and leading at opposite ends through reduction orifices 118 (best shown in Figs. 6, 10, 12, 11), annular channels 119 about opposite ends of the bushing, and radial ports 121 through the bushing to opposite ends 122, 123 of the valve chamber. The left end 122 of the valve chamber is connected (Figs. 6, 8, 11, 12) by means of the radial ports 121 and a housing passage 124 with a port 125 leading into a drag valve chamber 126. The opposite end 123 (Figs. 10, 9, 11, 12) of the distributor valve chamber is connected to the drag valve chamber 126 by means of the radial ports 121, a passage 127 and a port 128. The drag valve chamber 126 is connected to the outside of the housing by a pair of vents 129, 131.

The drag valve 96 is in the form of an elongated rod having between its ends a neck portion 132. It is supported in a bushing 133 for reciprocable movement in the drag valve chamber 126. The bushing is press fitted in one end of the drag valve chamber. The rear end of the latter chamber is closed by the closure plate 59. A forward end of the drag valve extends through a slightly larger hole in the disc 24 into a recess 134 formed in the forward face of the disc; and it is press fitted in the body of a forked plate 135 depending in the recess. The forked plate engages about a neckpiece 136 of the piston rod extending beyond the piston into the recess 134. By means of this arrangement, the drag valve is reciprocable as a unit with the piston.

To facilitiate description of the operation of the device reference is directed to Fig. 1 and to the schematic showings in Figs. 11 and 12. It is assumed that the duct rodder has been inserted in the duct as in Fig. 1 for travelling in a forward direction, and that the gripper elements 45 and 68 are flexed rearwardly by the wall of the duct, as shown in broken line. Figs. 1 and 11 show the piston 27 together with the connected drag valve 96 in a returned rearward position, and further show the distributor valve 95 together with the nylon end plugs 99 in forward position. In this position, the right end land 137 of the distributor valve blocks off communication of the radial ports 105 from the right end of the distributor chamber; the center land 138 blocks off communication of the radial ports 92 from the radial ports 104; and the other end land 140 blocks off the radial ports 103 from the radial ports 102.

Operating air now flowing from the supply passage 87 and inlet port 89 into the intake channel 91 flows in part through port 116, the control passage 117 and in a thin stream through the orifices 118 to opposite ends 122, 123 of the distributor valve chamber. A rearward position (Figs. 1, 11) of the drag valve at this time seals over port 125 associated with the left end 122 of the distributor valve chamber so that air flowing to this end is blocked from passing through the drag valve chamber 126 to the vent 131. This condition causes air pressure to build

up in the space at the left end of the distributor valve chamber, since the area about the neck 132 of the drag valve provides communication with the vent 129 of port 128 associated with the right end 123 of the distributor valve chamber. The unbalanced pressure condition developed at opposite ends of the distributor valve at this time holds the latter in its forward condition. Simultaneously with the flow of operating air to the ends 122, 123 of the distributor valve chamber, operating air flows in larger volume from the intake channel 91 through the radial ports 92 to the interior of the bushing around the neck 143 of the distributor valve, and then flows out through radial ports 103 to the passage 111 and connecting radial ports 112 leading to the rear of the piston chamber. There is a loose fit of the piston 27 rearwardly of the peripheral O-ring 139 enabling operating air to bleed around the piston to its rear. Due to the positioning of the radial ports 112 slightly forward of the rear of the piston chamber, the piston never moves fully to the rear end of the piston chamber because of cushioning air becoming trapped behind the piston, as at 141. Under pressure of the operating air developing at its rear, the piston moves forwardly to push the forward gripper 45 a corresponding distance into the duct, while at the same time the rear gripper 68 holds the housing stationary, as earlier explained. As the piston moves forwardly, substantially all of the air trapped at the forward end of the piston chamber vents through radial ports 114, the intake-exhaust passage 113, the radial ports 104 to the interior of the bushing, around the neck 142 of the distributor valve and out through radial ports 105 to the vent passage 115.

As the piston moves forwardly, it pulls the drag valve 96 with it, causing the rear portion of the drag valve, as appears in Fig. 12, to move clear of the port 125 associated with the left end 122 of the distributor valve chamber, and to seal over the vent port 129 associated with the right end 123 of the distributor valve chamber. Accordingly, the left end 122 of the distributor valve chamber now becomes vented through port 125, the drag valve chamber 126, and the vent passage 131; and operating air is now allowed to build up at the right end 123 of the distributor valve chamber to cause the distributor valve together with its nylon plugs to shift leftward to its second position, as shown in Fig. 12. In this latter condition of the distributor valve, the rear end of the piston chamber 26 is in communication through the corresponding intake-exhaust passage 111, ports 103, and 102 of the distributor valve chamber with the vent passage 110; and the forward end of the piston chamber is in communication through the corresponding intake-exhaust passage 113, and ports 104, 92 with the air supply channel 91. Accordingly, operating air which is continually flowing in a steady thin stream from the channel port 116 to opposite ends 122, 123 of the distributor valve chamber, now also flows from the intake channel 91 in large volume through the radial ports 92 to the interior of the bushing, around the neck 142 of the distributor valve and out through the radial ports 104 to the channel 108 and the associated intake-exhaust passage 113 leading through the radial ports 114 to the forward end of the piston chamber. The operating air entering the radial ports 114 bleeds around the looseness of the piston forwardly of the seal ring 139 to the front of the piston. The radial ports 114 are also located slightly away from the front end of the piston chamber so that the piston never fully reaches the forward end of the piston chamber because of a cushion of air that becomes trapped at its forward end. Operating air now building up forwardly of the piston exerts a rearward axial pull, as earlier explained, upon the forward gripper 45 causing the latter to firmly grip the duct and hold the piston stationary, whereupon the operating air forces the housing 20 forwardly relative to the piston to the condition shown in Figs. 1 and 11, and drags the rear gripper forwardly a corresponding distance. This forward movement of the housing relative to the piston and drag valve causes the drag valve 96 to move rearwardly in its chamber to seal from vent 131 port 125 connected to the left end 122 of the distributor valve chamber, and to communicate by means of its neck section 132 vent 129 with port 128 communicating with the right end 123 of the distributor valve chamber. Following this action of the drag valve, air building up at the left end 122 of the distributor valve chamber forces the distributor valve to the right to the position shown in Fig. 1. This operating cycle of the piston and housing, and the consequent step-by-step movement of the duct rodder through the duct continues automatically until the operator shuts off the air supply.

If, because of an obstruction in the duct, the duct rodder is prevented from advancing further, a forceful yank upon the lead line 75 in a rearward direction will cause the resilient legs of both grippers to flip over and flex in the opposite direction. This reversed condition of the legs of the grippers enables the duct rodder to travel rearwardly out of the duct. If desired, the duct rodder in this reverse condition may be pulled rearwardly by means of the lead line from the duct.

It is to be noted that each of the gripping elements has six legs spaced equally apart. This number is of advantage in that each leg is opposed by another leg and thus the inward radial thrust of each leg upon the body of the gripper element is counterbalanced by that of

an opposing leg. While it is preferably that the gripping strength of the forward gripper element 45 be greater for the reasons mentioned, than that of the rear one 68, nevertheless, the rear gripper element may be the same in gripping strength as the forward one and may also be the same in structure.

In Figs. 13 and 14, studs 145 are shown embedded in the legs of a resilient flexible gripper 146 and projecting from the beveled surface areas 57 of its legs. The studs are formed of a rear resistant material, such as tungsten carbide. In this construction, the studs are adapted to grip the duct wall. This reduces wear at the duct contacting ends of the legs and thereby prolongs the life of the gripper. The broken line in Fig. 14 shows the legs of the gripper in flexed relation to the duct 21.

The duct grippers thus far described are circular in configuration, and are preferably for use in ducts of circular cross section. It is understood that such ducts may be manufactured with diameters of different sizes. A duct of conventional size has a diameter of approximately three and one-half inches. Another conventional size duct has a diameter of approximately four inches. However, it is understood that the size of the gripper to be used with the duct rodder will be proportioned for best results to the diameter size of the duct in which it will be used, so that it will be of a diameter a little greater than that of the duct.

Besides the circular or round duct, there also are square ducts. It is preferable, when the duct rodder is to be used in a square duct, that the grippers mounted to the duct rodder be modified in the arrangement of their legs so as to provide desirable contact with the interior wall area of the duct.

Figs. 15 and 16 illustrate examples of grippers which are especially suited for use in square ducts. These grippers are of a construction similar to those earlier described, except for the arrangement of their legs. The legs of these grippers may also have beveled surfaces 57; and the studs 145 shown in Fig. 13 may also be used with the legs of these grippers.

The gripper illustrated in Fig. 15 has eight legs 147 so arranged that a separate pair is engageable with a separate wall of the duct. The cross dimension of the gripper is a little greater than that of the duct in which it will be used so that the legs will be flexed into contact with the duct walls when entered into the duct.

The gripper illustrated in Fig. 16 has four legs 149 arranged substantially ninety degrees apart, which legs are designed to engage a separate corner 150 of a square duct 151. Each corner 150 of the square duct, as shown in Fig. 17, conventionally has a slight radius of curvature and the end of each leg 149 is similarly rounded. The diagonal dimensions of the legs 149 are slightly greater than those of the square duct so that the legs will be flexed into contact with the corners when entered into the duct. It is also understood that a gripper (not shown) similar to that shown in Fig. 16 may be formed having a leg between each of the legs 149 for contact with each side wall of the duct.

While mounting holes 148 of the several grippers described herein are round, it is understood, however, that the mounting holes may be of polygonal form to accommodate complementary mounting supports.

WHAT WE CLAIM IS:

1. A duct rodder designed to travel step by step through a duct, including a motor comprising a housing and a piston means, one movable axially relative to the other a measured distance when the other is held stationary; and means cooperable with the wall of the duct for holding the housing and piston alternately stationary so as to permit alternate axial movement of one relative to the other, the said means comprising a pair of resilient flexible grippers of greater diameter than the duct, one fixed to the housing and the other fixed to the piston means, both grippers adapted when entered into the duct to be forced by the surrounding duct wall to flex in a particular direction, each gripper adapted when pressured axially in one direction to expand radially and grip the duct wall so as to hold the corresponding housing or piston means as the case may be stationary, and adapted when axially pressured in the opposite direction to yieldably relax its grip on the duct wall so as to allow the corresponding housing or piston means as the case may be to move axially relative to the other.

2. A duct rodder as in Claim 1, wherein at least one of the grippers is of uniform axial thickness and is formed of a tough plastic material.

3. A duct rodder as in Claim 1, wherein one of the grippers is defined by a central body having a plurality of legs extending from the body in the same plane as the body.

4. A duct rodder as in Claim 3, wherein each leg of the gripper has a beveled peripheral edge facing forwardly relative to the housing adapted to contact the duct wall.

5. A duct rodder as in Claim 3, wherein a wear resistant stud is embodied in each leg, projects through the periphery of the leg and is adapted upon flexing of the leg in a particular direction to engage the duct wall.

6. In a duct rodder as in Claim 1, means for selectively reversing the flexed condition of both duct grippers after they have been entered into the duct.

7. For use with a duct rodder, a duct gripping element attachable to a support of the duct rodder, the element being formed of

flexible resilient material, the element being of greater cross dimension than the duct rodder and having a central body portion, a group of legs lying in the same plane as and integral with the body portion.

8. A duct gripping element as in Claim 7, wherein the flexible resilient material is a tough wear resistant plastic.

9. A duct gripping element as in Claim 7, wherein the legs are spaced equally apart circumferentially and are six in number.

10. A duct gripping element as in claim 7, wherein each leg has a peripheral beveled forward edge.

11. A duct gripping element as in Claim 10, wherein a wear resistant stud is embodied in the beveled edge of each leg and projects externally of said edge.

12. A duct gripping element as in Claim 7, including means for mounting the element axially to the support comprising a hole axially of the body portion for receiving the support, an annular member on the support providing a backing face for a corresponding face of the body portion of the element, and annular abutment means adapted to be received on the support and drawn tight against the opposite face of the body portion of the element.

13. A duct gripping element as in Claim 12, which is flexible selectively in a forward or rearward direction relative to the support.

14. A duct rodder substantially as described with reference to the accompanying drawings.

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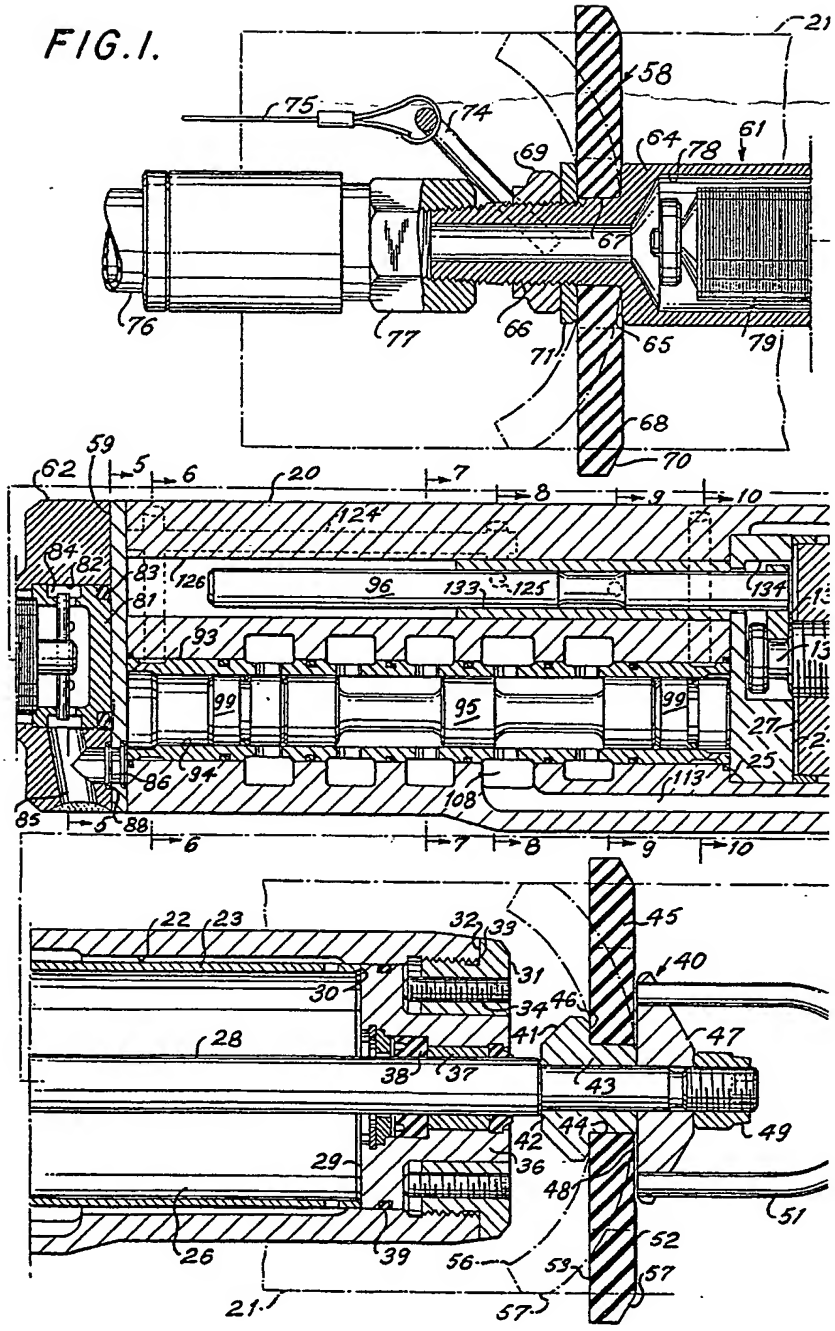
FIG. 1.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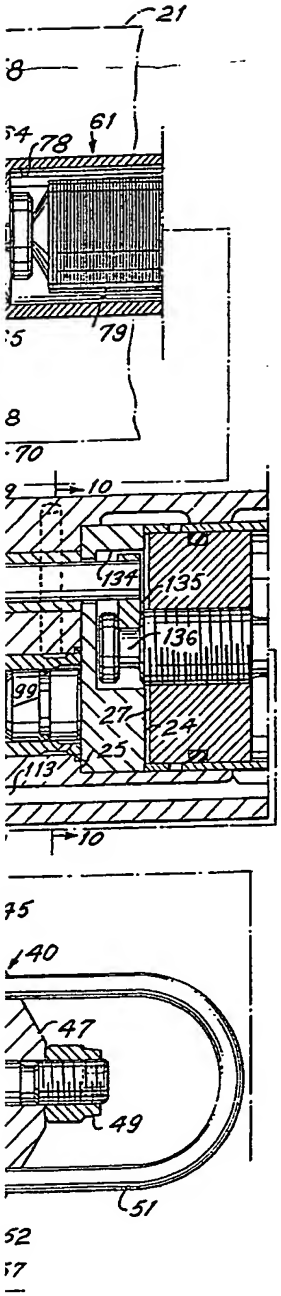


FIG. 2.

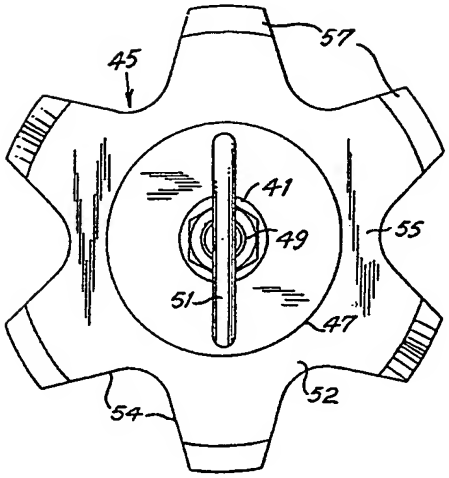
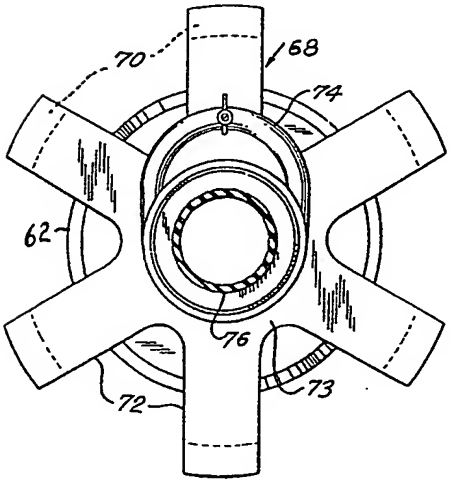


FIG. 3.



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Sheet 1

FIG. 1.

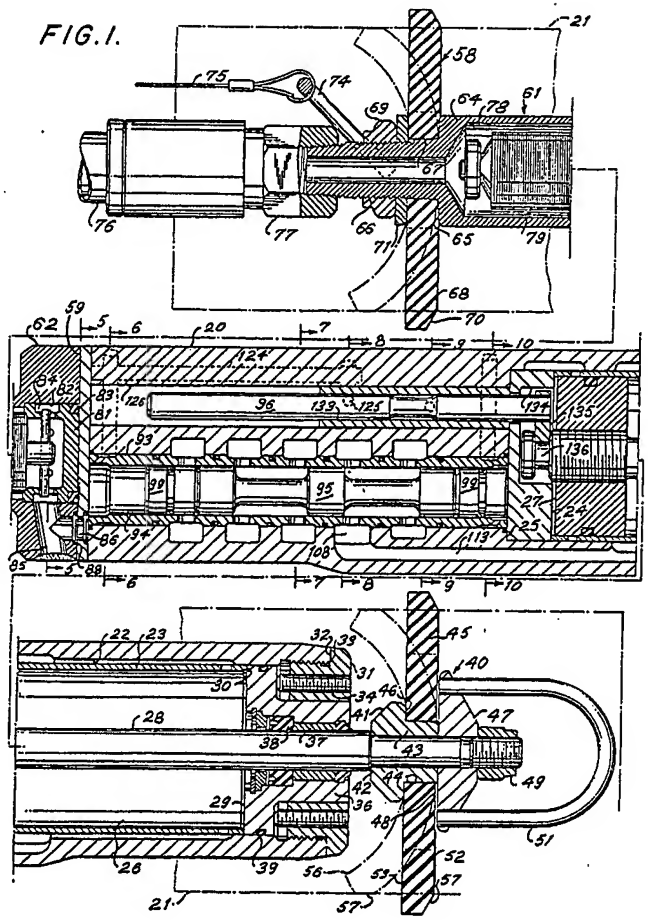


FIG. 2.

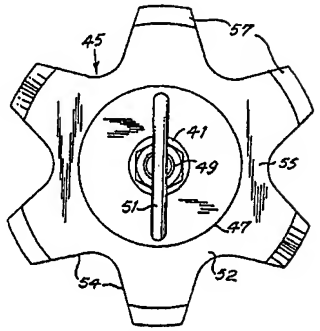
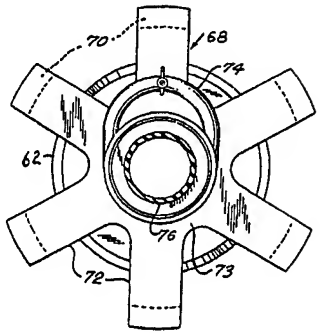


FIG. 3.



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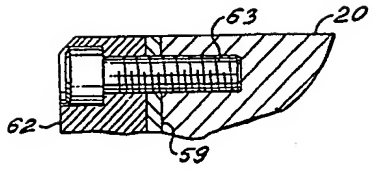
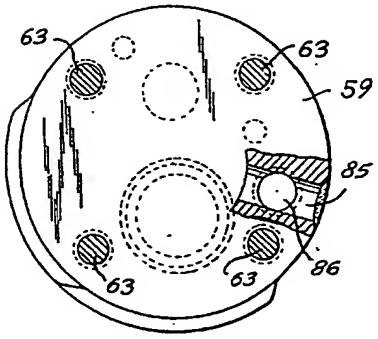


FIG. 5.



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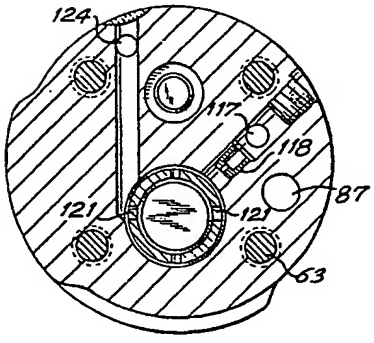

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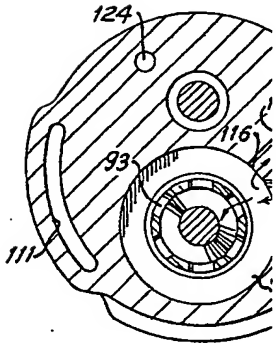

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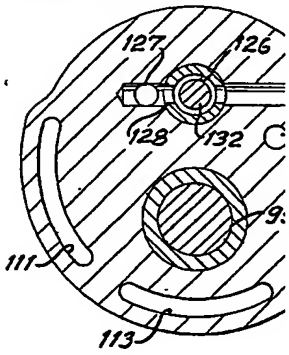
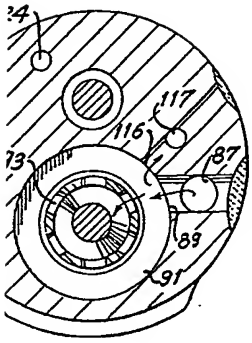


1124732 COMPLETE SPECIFICATION
4 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 2

FIG. 7.



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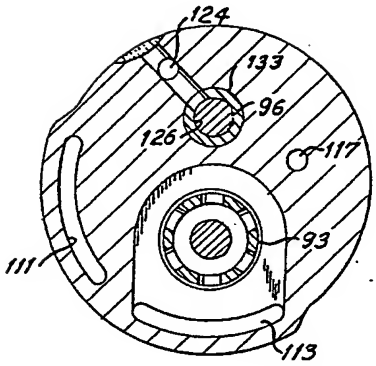


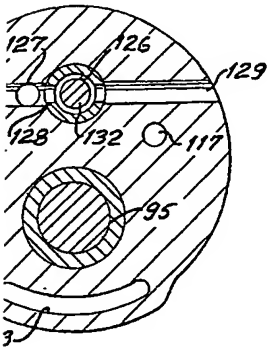
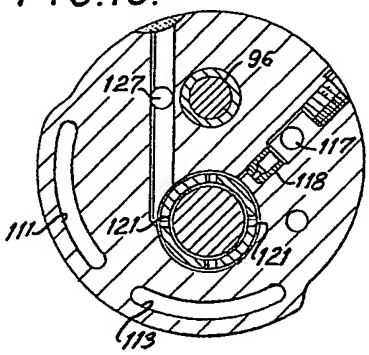


FIG. 10.



1124732 COMPLETE SPECIFICATION
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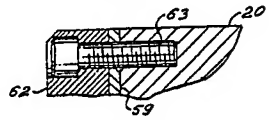
FIG. 4.



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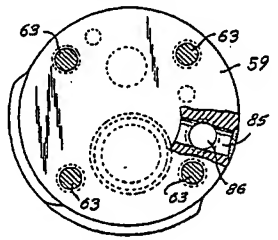

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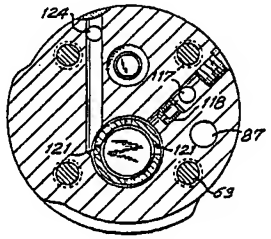

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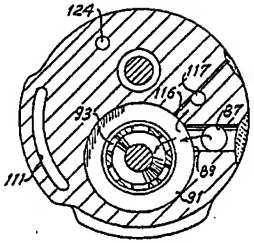

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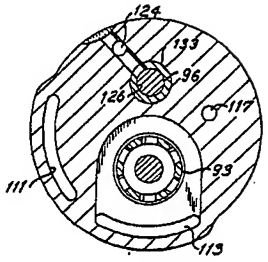

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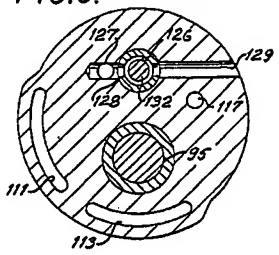

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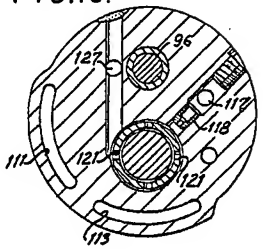

FIG. 11

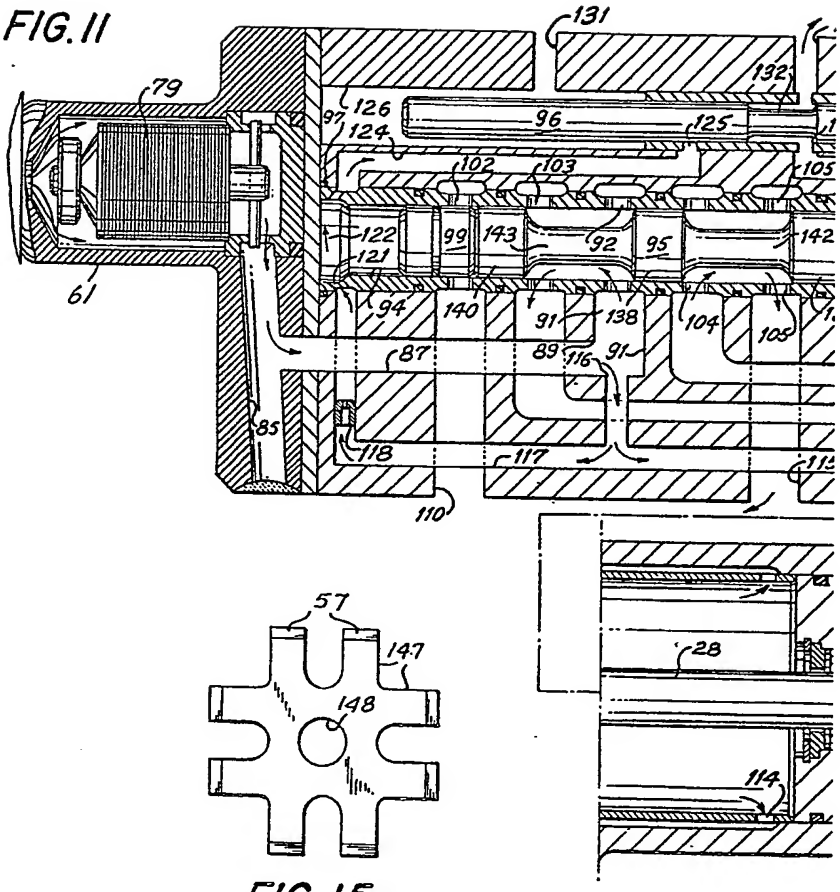
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FIG. 15

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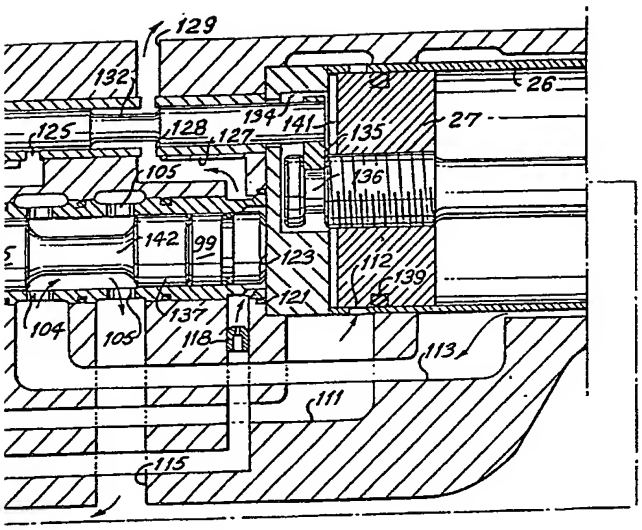


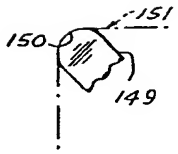
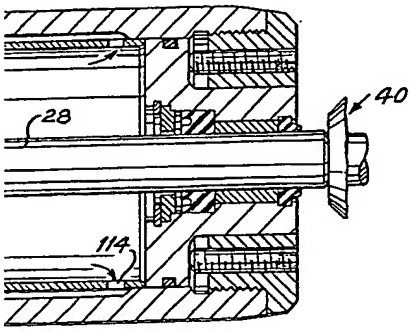


FIG. 17



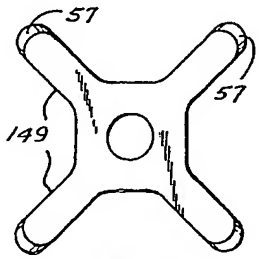


FIG. 16

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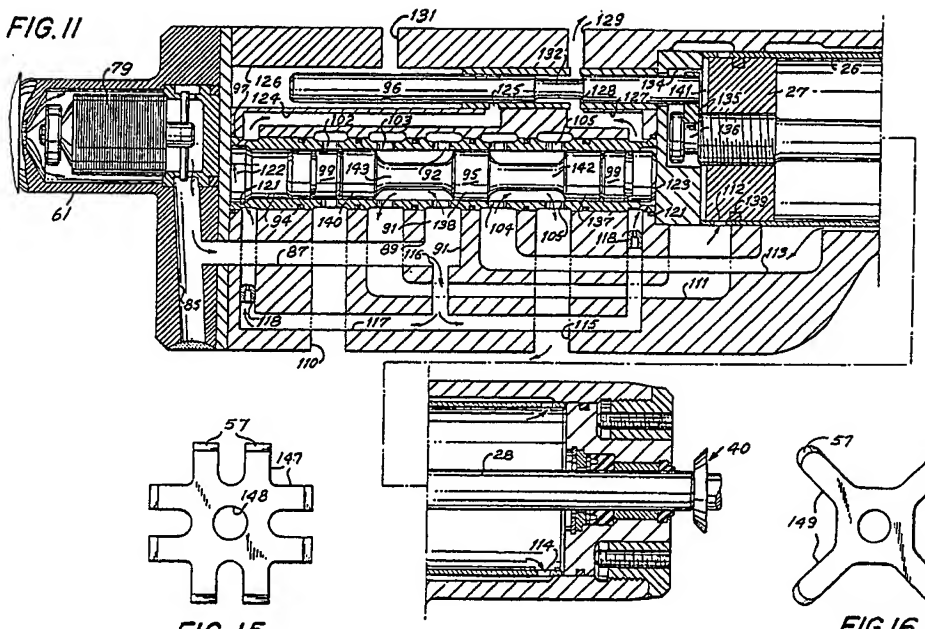
FIG. 11



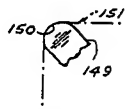


FIG. 17

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FIG. 16

FIG. 12.

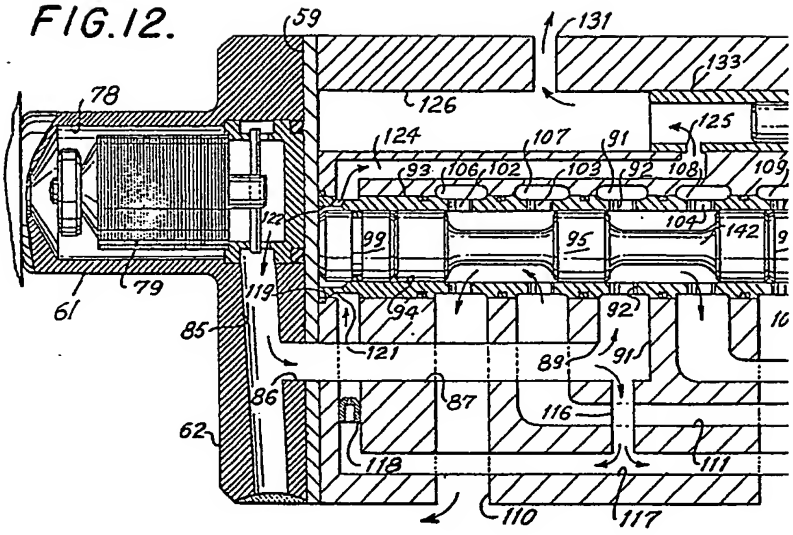
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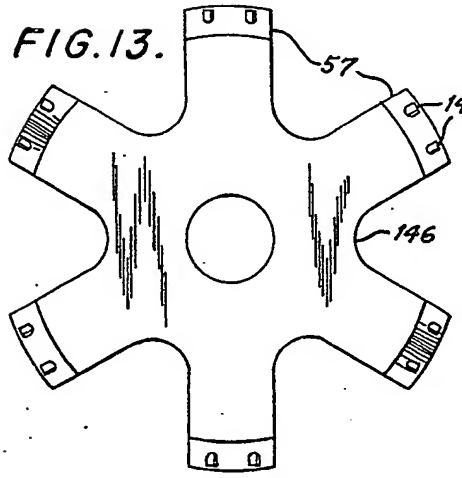
FIG. 13.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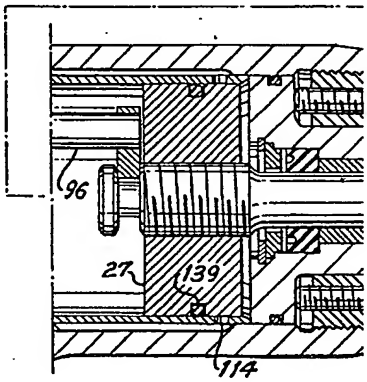
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4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 4

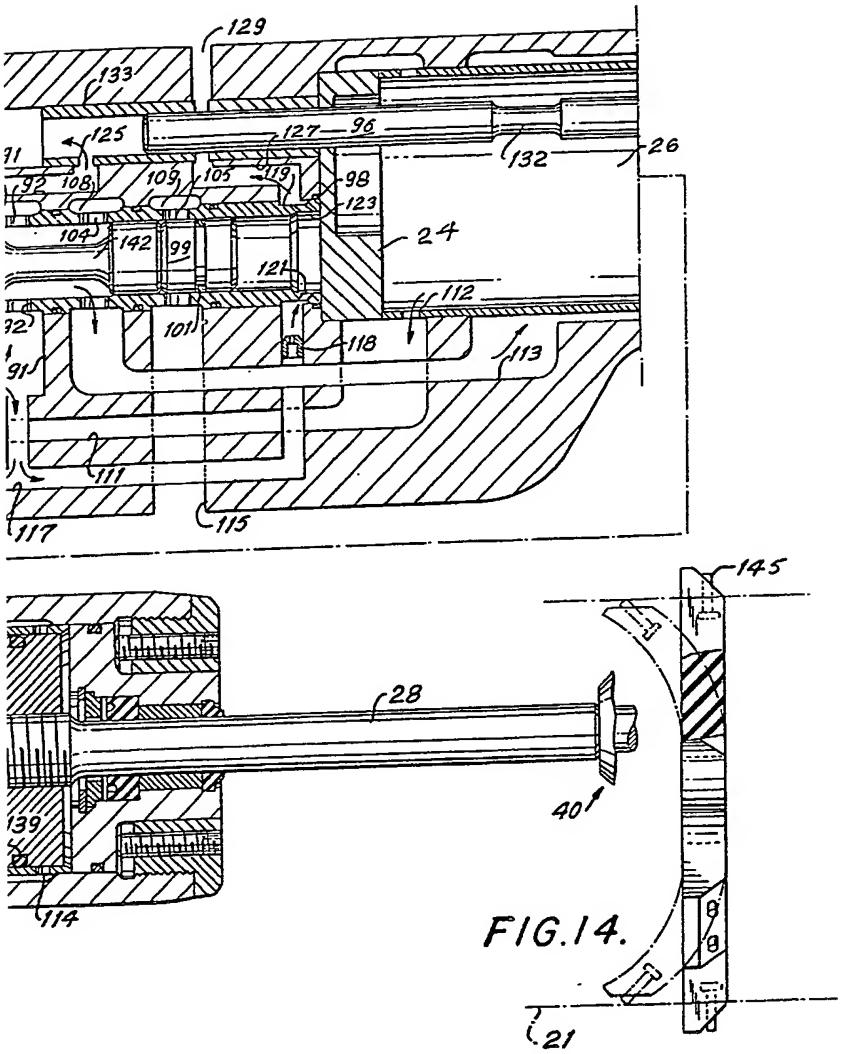

FIG. 14.

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FIG.12.

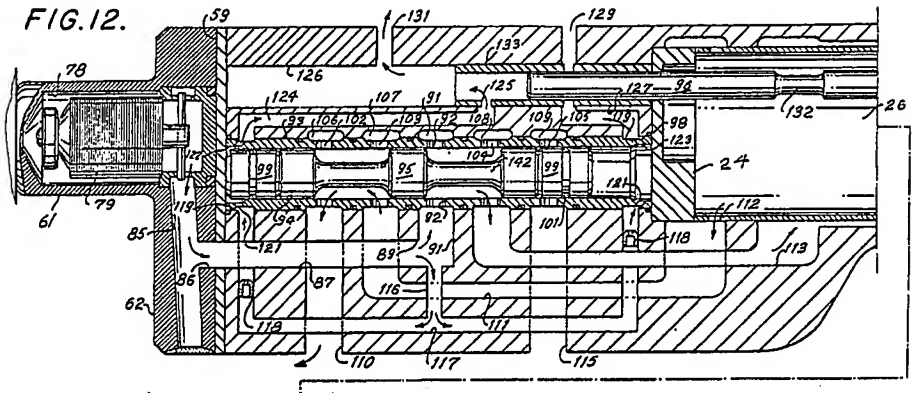
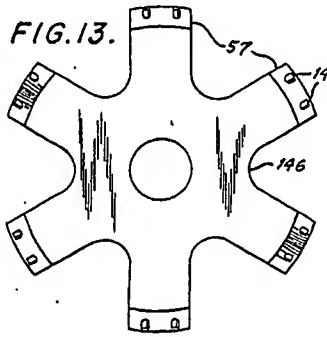


FIG.13.



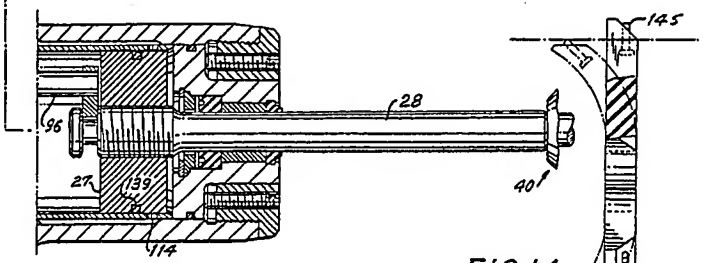


FIG.14.

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